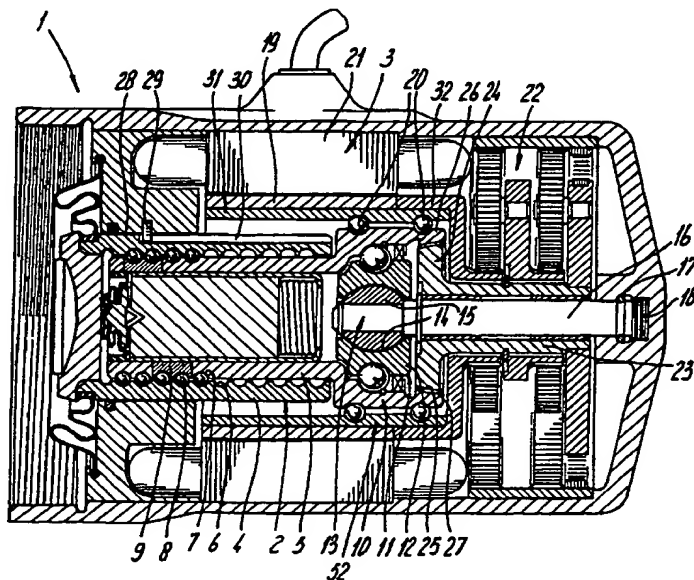




## INTERNATIONAL APPLICATION PUBLISHED UNDER THE PATENT COOPERATION TREATY (PCT)

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(71) Applicant (for all designated States except US): SKF ENGINEERING AND RESEARCH CENTRE B.V. [NL/NL]; Postbus 2350, NL-3430 DT Nieuwegein (NL).			
(72) Inventors; and (75) Inventors/Applicants (for US only): KAPAAN, Hendrikus, Jan [NL/NL]; Waterhoen 5, NL-3425 DM Nieuwegein (NL). VAN WINDEN, Johannes, Albertus [NL/NL]; Molenva 4, NL-3421 CM Oudewater (NL). ZWARTS, Jacobus [NL/NL]; Carmenlaan 5, NL-3438 VA Nieuwegein (NL). FUECKS, Thomas, Wilhelm [DE/DE]; Salierallee 54, D-52066 Aachen (DE).		<b>Published</b> <i>With international search report.</i> <i>Before the expiration of the time limit for amending the claims and to be republished in the event of the receipt of amendments.</i>	
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(54) Title: COMPACT ACTUATOR



## (57) Abstract

An actuator comprises a housing (1) accommodating a screw mechanism (2) and a drive comprising a motor (3), said screw mechanism comprising a nut (4) and a screw (5) one of which is rotatably supported with respect to the housing, such that upon relative rotation of the nut and the screw a linear movement of one said nut and screw is obtained. At least a rotatable component of the drive, e.g. the rotor (19) of the motor, is rotatably supported on the screw which is rotatably supported with respect to the housing.

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Compact actuator

The invention is related to an actuator, comprising a housing which contains a screw mechanism and a motor, said screw mechanism comprising a nut and a screw, one of which is rotatably supported with respect to the housing, such that upon relative rotation of the nut and the screw a linear movement of one of said nut and screw is obtained.

In certain applications, such as actuators for disc brakes, clutches etcetera, it is desirable to limit the overall dimensions and possibly the weight as much as possible. According to the invention, a compact layout may be obtained in that at least a rotatable component of the drive, e.g. the rotor of the motor, is rotatably supported on the screw which is rotatably supported with respect to the housing.

In particular, in case the screw is rotatably supported with respect to the housing by means of a support bearing, the screw may be integrated with the outer ring of the support bearing, such that the rotor of the motor, by means of an auxiliary bearing, is rotatably supported on the outer ring of the support bearing.

The support bearing is preferably accommodated with the auxiliary bearing. In such embodiment, a compact and stiff support for the rotor and screw is obtained.

The linear movement provided by the actuator usually generates a force, e.g. in the case of a disc brake for clamping the brake pads onto the brake disc.

As a result of the inevitable flexibility of the actuator and the system to which said actuator is connected, elastic deformations are also generated.

In so far as these deformations are axial-symmetric with respect to the screw mechanism, no problems occur as to the proper function of the actuator. However, in certain cases, and in particular in the case of disc brakes, loads are generated which are eccentric with respect to the actuator.

The eccentricity is to be attributed to the asymmetric shape of the brake calliper, in particular of the claw piece thereof which carries the brake pads and which accommodates the brake disc sideways.

Upon pressing the brake pads onto the brake disc, the claw piece is loaded in bending, which bending action is also transferred onto the housing of the actuator. As the screw mechanism is supported within the housing, said mechanism may become exposed to bending as well.

The screw mechanism is however rather vulnerable with respect to misaligned forces, in such a way that the proper function may be hampered and that damage may occur.

5 The object of the invention is therefore to provide an actuator of the type described before, which is less vulnerable with respect to misaligned forces. This object is achieved in that the screw mechanism is supported with respect to the housing by means of a joint which allows rotations about at least one axis transverse with respect to said linear movement.

10 In case the housing of the actuator is loaded in bending, said bending action is relieved as a result of the freedom of the screw mechanism to rotate around the transverse axis or axes. Thus, the screw mechanism will not be exposed to misaligned forces.

15 In particular, one of the nut and screw is rotatably supported both according to an axis parallel with respect to said linear movement, and according to at least one axis transverse with respect to said linear movement. Said transverse rotation may be obtained by means of a ball joint.

Said ball joint may be situated at one end of a central support shaft, the other end of which is connected to the housing. According to a preferred embodiment, said ball joint may be connected to a support bearing supporting one of the nut and the screw, 20 said one of the nut and the screw being drivably connected to the rotor of the motor.

The motor, preferably an electric motor, may engage the screw mechanism in several different ways. Usually, said motor is also connected to the housing, which means that the connection between the motor and the screw mechanism is also exposed to the elastic bending action of the housing under brake load.

25 Misalignment can be avoided here in case the nut and the screw engages the rotor through a coupling which allows rotations about at least one axis transverse with relation to the linear movement.

Said coupling may comprise an internally toothed member as well as an externally toothed member having equal number of teeth. The bending action of the 30 housing can be accommodated in particular in case the teeth of the externally toothed member are convexly curved in a cross-section parallel to the linear movement, and in case the teeth of the externally toothed member are centred with respect to the ball joint.

A compact embodiment is obtained in case the outer ring of the bearing is integrated with an internally toothed member. The screw and the internally toothed member are at axially opposite ends of the outer ring.

Conveniently, the rotor of the motor is rotatably supported on the outer ring of the support bearing.

According to a first embodiment, the rotor engages an externally toothed member through a reduction gear mechanism. Preferably, the support bearing is supported on one end of a support shaft, the other end of which is connected to the housing, the externally toothed member being rotatably supported on said support shaft.

The invention will now be described with reference to the embodiments shown in the figures.

Figure 1 shows a first embodiment in longitudinal section.

Figure 2 shows an exploded view of the embodiment according to figure 1.

Figure 3 shows a second embodiment.

Figure 4 shows a third embodiment.

The actuator shown in figures 1 and 2 comprises a housing 1 containing a screw mechanism 2 and a motor 3. Said screw mechanism 2 comprises a nut 4 and a screw 5, provided with screw threads 6, 7 and which engage each other by means of a number of balls 8. At the location of the inserts 9, the balls are transferred between adjacent windings of the screw threads 6, 7.

The screw is integrated with the outer ring 10 of support bearing 11. The outer ring 10 has a larger diameter than the screw 5, for reasons of compactness of the actuator.

The inner ring 12 of the support bearing 11 is integrated with a ball joint 13. In particular, the inner ring has a spherical inner surface 14, which engages a ball 15 connected to the central support shaft 16.

Although the ball 15 is depicted as a separate part, it may also be carried out in one piece with the central support shaft 16. The central support shaft 16 is connected to the housing through the clip ring arrangement 17, and load cell 18 for measuring axial forces.

The rotor 19 of the motor 3 is supported with respect to the outer ring of the support bearing 11 by means of a sleeve 31 having integrated bearings 20. Said sleeve 31 is fixed to the stator 21. The stator 21 of the motor 3 is fixably connected to the

housing 1. Furthermore, the sleeve 31 is fixed to sleeve 32 of a reduction gear wheel mechanism 22.

By means of the reduction gear wheel mechanism 22, the motor 3 drives the sleeve 23, which carries an outwardly toothed member. This outwardly tooth member  
5 has teeth 25, which have a curved shape.

The outer ring 10 of the support bearing 11 carries an inwardly toothed member 26, which carries inwardly directed teeth with a correspondingly curved shape.

The number of outwardly directed teeth 25 and inwardly directed teeth 27 is equal. These teeth engage each other so as to transfer the driving action from the sleeve  
10 23 onto the screw 5.

The nut 4 is carried out as a piston which is slidably held in a cylindrical space 28 in the housing 1. By means of pin 29 and groove 30 in the cylinder, said cylinder is held axially movable, but non-rotatable within the cylinder space 28.

Upon actuating the screw 5, the nut is therefore driven linearly and in axial  
15 direction with respect to the housing 1, e.g. for driving the brake pads of a brake calliper (not shown) towards and from each other.

In case, as a result of the forces generated in the housing 1, e.g. the housing of a brake calliper, a flexible bending is imposed thereon, the screw mechanism 2 is still protected against such loadings. Generally, screw mechanisms have a poor resistance  
20 against bending action, and the screw mechanism 2 in question is relieved from any bending loads due to the ball joint 13.

Also, the driving connection between motor 3 and screw mechanism 2 is relieved from any bending loads due to the teeth drive of the inwardly tooth member 26 and the outwardly tooth member 24, and the curved shape of the teeth in question.  
25 The embodiment of figure 3 shows a brake calliper 40, comprising a housing 1 connected to claw piece 41 by means of screw thread. At its side facing the actuator 1, the claw piece 41 has a cavity 43 in which part of the stator 21 of motor 3 has been accommodated. Thereby, a very compact brake calliper 40 is obtained.

As usual, the claw piece 41 has a fixed brake pad 44 as well as a movable brake  
30 pad 45 which is connected to the nut 5 of the screw mechanism 2, in particular to the head 46 thereof.

Between the brake pads 44, 45, a brake disc 47 is accommodated.  
The support shaft 16 supports the support bearing 11, the inner ring 12 thereof being

fixedly connected by means of e.g. a clip ring 48.

In this embodiment, the inner ring 12 of support bearing 11 has a closed head 49, such that a load cell 50 can be accommodated between said closed head 49 and the facing end of support shaft 16.

5 The other components of this embodiment are to a large extent identical to the embodiment of figures 1 and 2.

In the embodiment of figure 4, it is shown that the external teeth 25 of the externally toothed member 24 are rounded off in longitudinal cross-section, so as to better allow bending deformations of the housing, without however transferring the  
10 bending action onto the screw mechanism 2.

A grease-dosing unit 53 is accommodated in the base of the screw 5.

Claims

1. Actuator, comprising a housing (1) accommodating a screw mechanism (2) and a drive comprising a motor (3), said screw mechanism (2) comprising a nut (4) and a screw (5) one of which is rotatably supported with respect to the housing (1), such that upon relative rotation of the nut (4) and the screw (5) a linear movement of one of said nut (4) and screw (5) is obtained, characterised in that at least a rotatable component of the drive, e.g. the rotor (19) of the motor (3), is rotatably supported on the screw (5) which is rotatably supported with respect to the housing.
2. Actuator according to claim 1, wherein the screw (5) is rotatably supported with respect to the housing (1) by means of a support bearing (11).
3. Actuator according to claim 2, wherein the rotatable component of the drive, e.g. the rotor (19) of the motor (3) is rotatably supported on the screw (5) by means of an auxiliary bearing (52).
4. Actuator according to claim 3, wherein the support bearing (11) is accommodated within the auxiliary bearing (52).
5. Actuator according to claim 2, 3 or 4, wherein the screw (5) is integrated with the outer ring (10) of the support bearing (11).
6. Actuator according to claim 5, wherein the outer diameter of the outer ring (10) of the support bearing (11) is larger than the outer diameter of the screw (5).
7. Actuator according to any of claims 2 - 6, wherein the outer ring (10) of the bearing (11) supports a rotatable sleeve (31) which is in connection with the rotatable component (19) of the drive.
8. Actuator according to claim 7, wherein the sleeve (31) comprises, or is connected to, the integrated outer ring of an auxiliary bearing, the inner ring of which is integrated with the outer ring (10) of the support bearing (11).
9. Actuator according to claim 8, wherein the sleeve (31) comprises two axially spaced raceways, each of said raceways engaging a number of rolling elements (20) which each engage a raceway on the outer surface of the outer ring (10) of the support bearing (11).
10. Actuator according to claim 7, 8 or 9, wherein the sleeve (31) is connected to the rotor (19) of the motor (3).
11. Actuator according to any of the preceding claims, wherein one of the nut (4) and



screw (5) is rotatably supported both according to an axis parallel with respect to said linear movement, and according to at least one axis transverse with respect to said linear movement.

12. Actuator according to claim 11, wherein one of the nut (4) and screw (5) is supported with respect to the housing by means of a ball joint (13).

13. Actuator according to claim 12, wherein the ball joint (13) is at one end of a central support shaft (16), the other end of which is connected to the housing (1).

14. Actuator according to claim 13, wherein the ball joint (12) is connected to a support bearing (11), said support bearing (11) supporting the screw (5), said one of the nut (4) and the screw (5) being drivably connected to the rotor (19) of the motor (3).

15. Actuator according to claim 14, wherein said one of the nut (4) and the screw (5) engages the rotor (19) through a coupling (25, 27) which allows rotations about at least one axis transverse with relation to the linear movement.

16. Actuator according to claim 15, wherein the coupling comprises an internally toothed member (26) as well as an externally toothed member (24) having equal number of teeth (25, 27).

17. Actuator according to claim 16, wherein the teeth (25) of the externally toothed member (24) are convexly curved in a cross-section parallel to the linear movement.

18. Actuator according to claim 16 or 17, wherein the teeth of the externally toothed member (24) are centred with respect to the ball joint (13).

19. Actuator according to any of claims 14-18, wherein the screw (5) is integrated with the outer ring (10) of the support bearing (11).

20. Actuator according to claim 19, wherein the outer diameter of the outer ring (10) of the support bearing (11) is larger than the outer diameter of the screw (5).

21. Actuator according to claim 19 or 20, wherein the outer ring (10) of the support bearing (11) is integrated with an internally toothed member (26).

22. Actuator according to claim 20, wherein the screw (5) and the internally toothed member (26) are at axially opposite ends of the outer ring (10) of the support bearing (11).

23. Actuator according to any of claims 19-22, wherein the rotor (19) of the motor (3) is rotatably supported on the outer ring of the support bearing (11).

24. Actuator according to claim 23, wherein the rotor (19) engages an externally toothed member (24) through a reduction gear mechanism (22).

25. Actuator according to claim 24, wherein the support bearing (11) is supported on one end of a support shaft (16), the other end of which is connected to the housing (1), the externally toothed member (24) being rotatably supported on said support shaft (16).
- 5 26. Actuator according to claim 19 or 20, wherein the rotor of the motor directly engages the outer ring of the support bearing.
27. Actuator according to claim 26, wherein the rotor is integrated with an internally toothed member, and the outer ring of the support bearing is integrated with an externally toothed member, said members engaging each other.
- 10 28. Actuator according to claims 13-27, wherein the screw (5) and the support shaft (16) each have a throughgoing bore, said bores being aligned with respect to each other.
29. Actuator according to any of claims 1-28, wherein the screw (5) comprises a bore, said bore containing a grease dosing unit (53).
- 15 30. Actuator according to any of the preceding claims, wherein at least one of the components of the screw mechanism, support bearing, auxiliary bearing and reduction gear mechanism comprises a surface obtained by hard turning.
31. Actuator according to any of the preceding claims, wherein at least one of the components of the screw mechanism, support bearing, auxiliary bearing and reduction
- 20 gear mechanism comprises a coating, e.g. a diamond-like carbon coating.
32. Actuator according to any of the preceding claims, wherein an encoder is provided for measuring a relative rotation.
33. Brake calliper for a disc brake, comprising a claw piece carrying at least two opposite brake pads which enclose a gap for accommodating a brake disc, and an
- 25 actuator according to any of the preceding claims, said actuator having a housing accommodating a screw mechanism and a drive comprising a motor, said screw mechanism comprising a nut and a screw one of which is rotatably supported with respect to the housing, such that upon relative rotation of the nut and the screw a linear movement of one of said nut and screw is obtained, said housing being connected to the
- 30 claw piece, characterised in that at least a rotatable component of the drive, e.g. the rotor of the motor, is rotatably supported on the nut or screw which is rotatably supported with respect to the housing.

fig-1

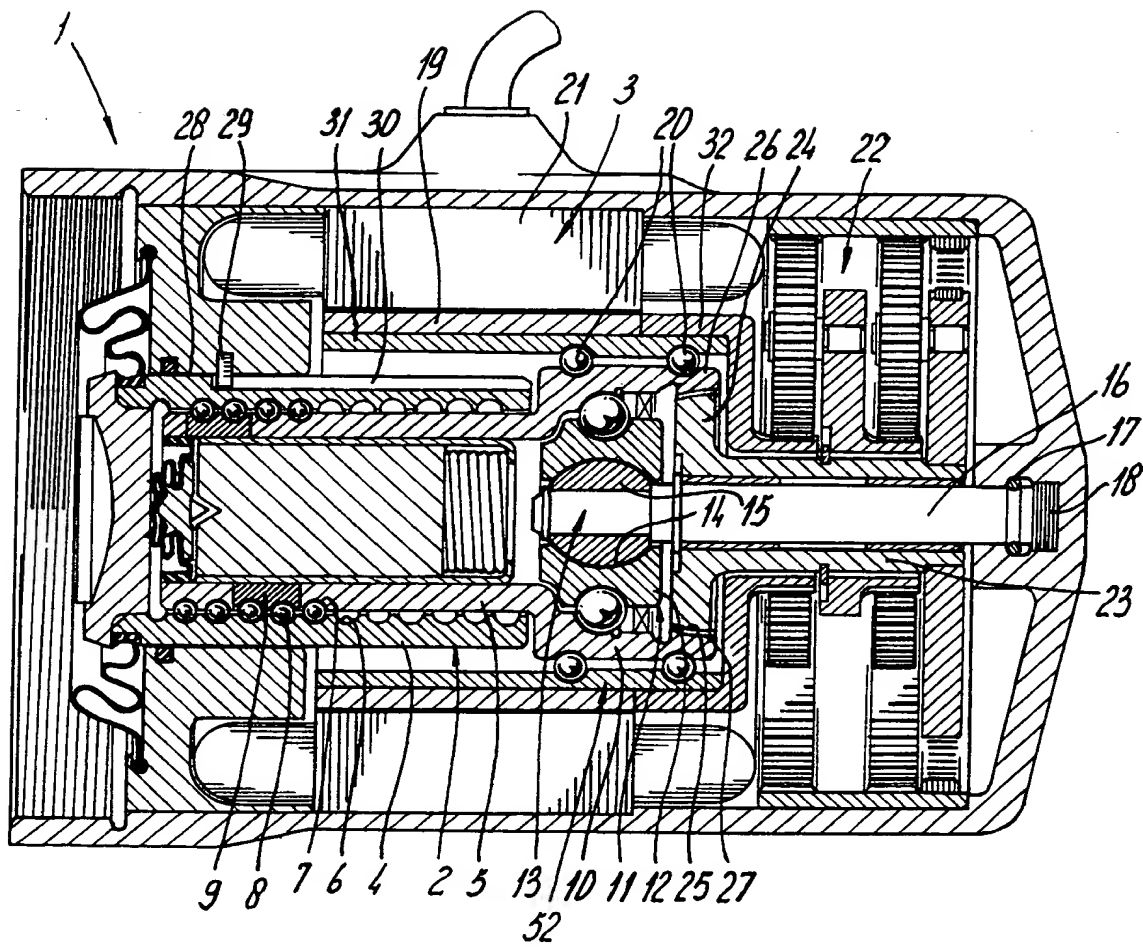


fig-2

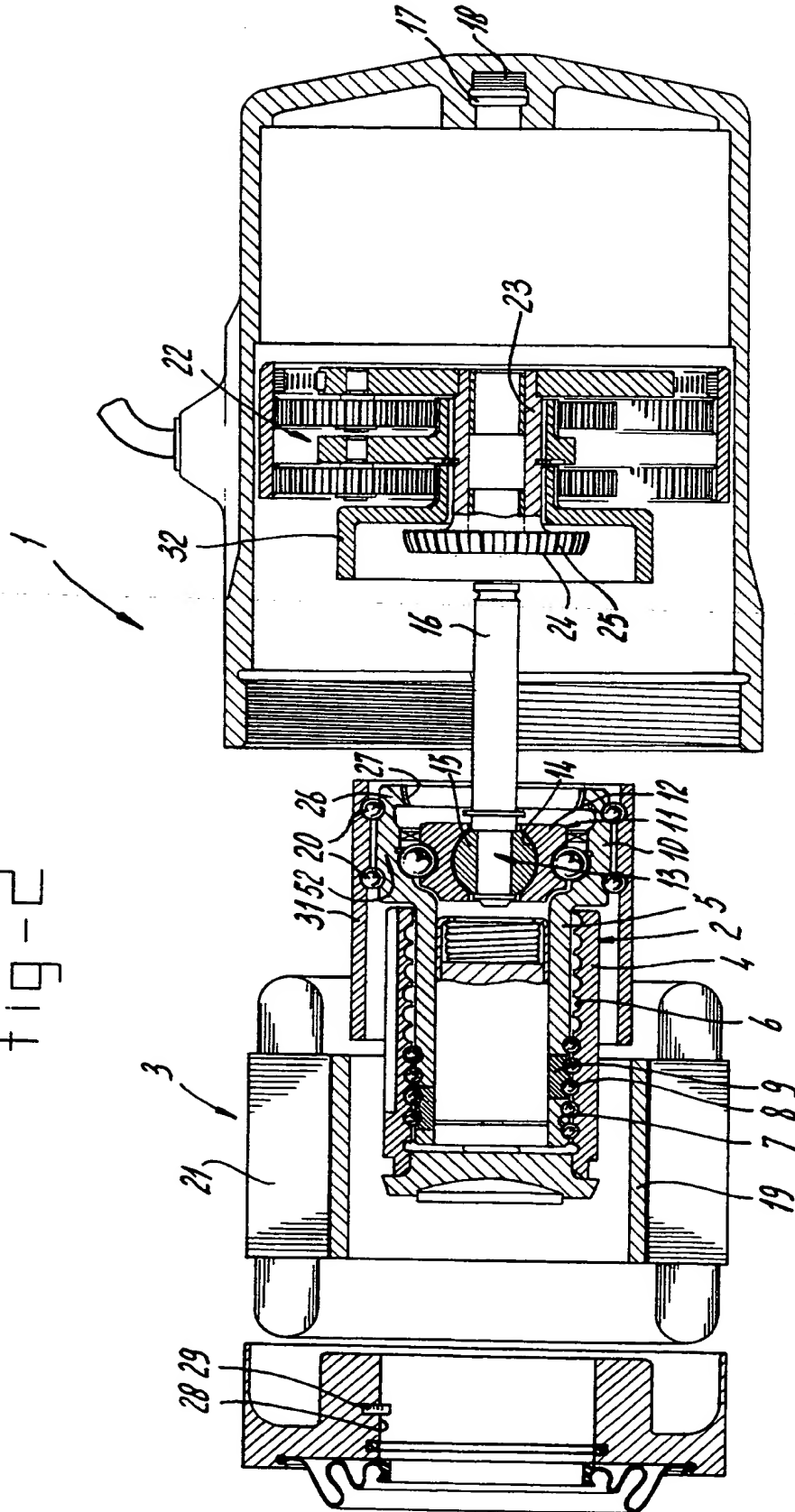


fig-3

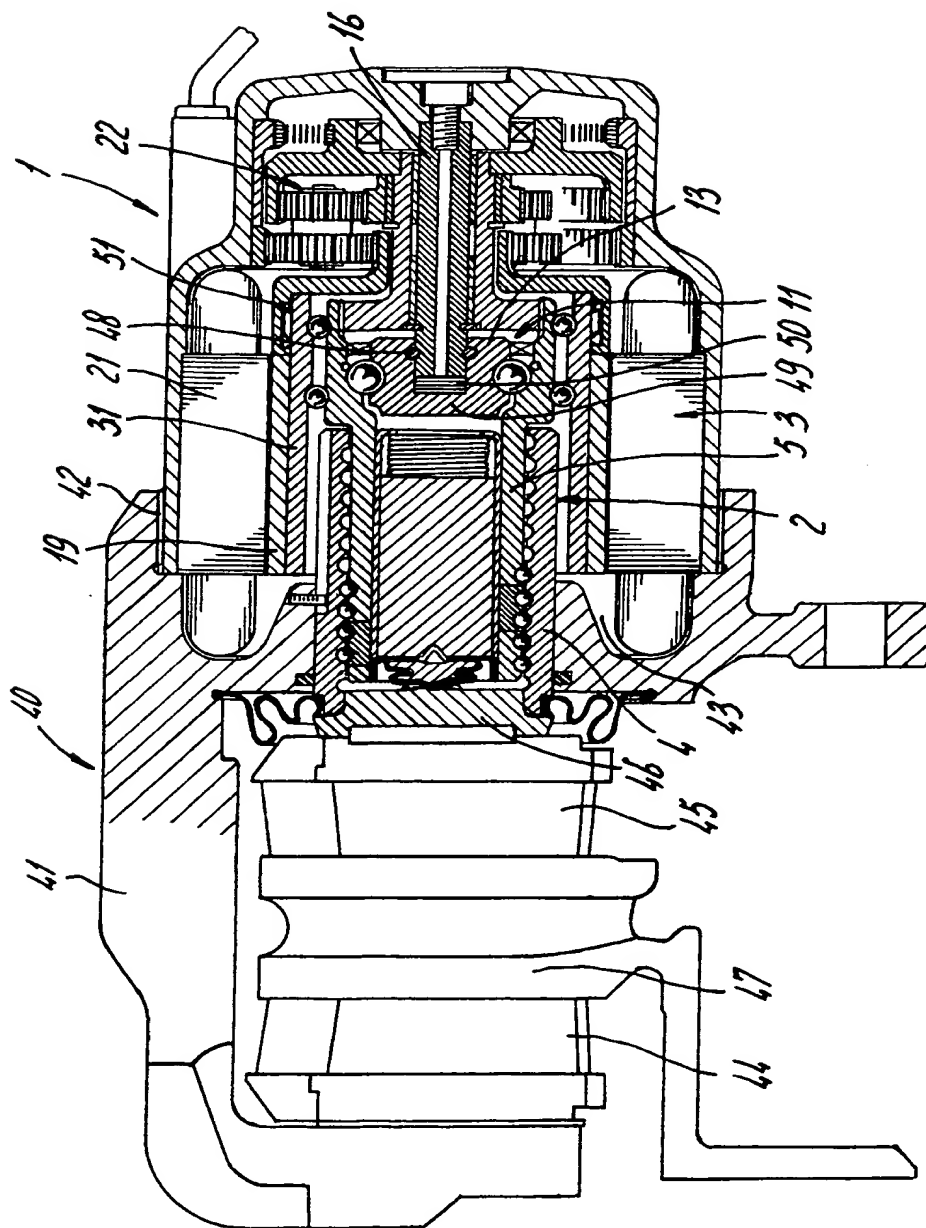
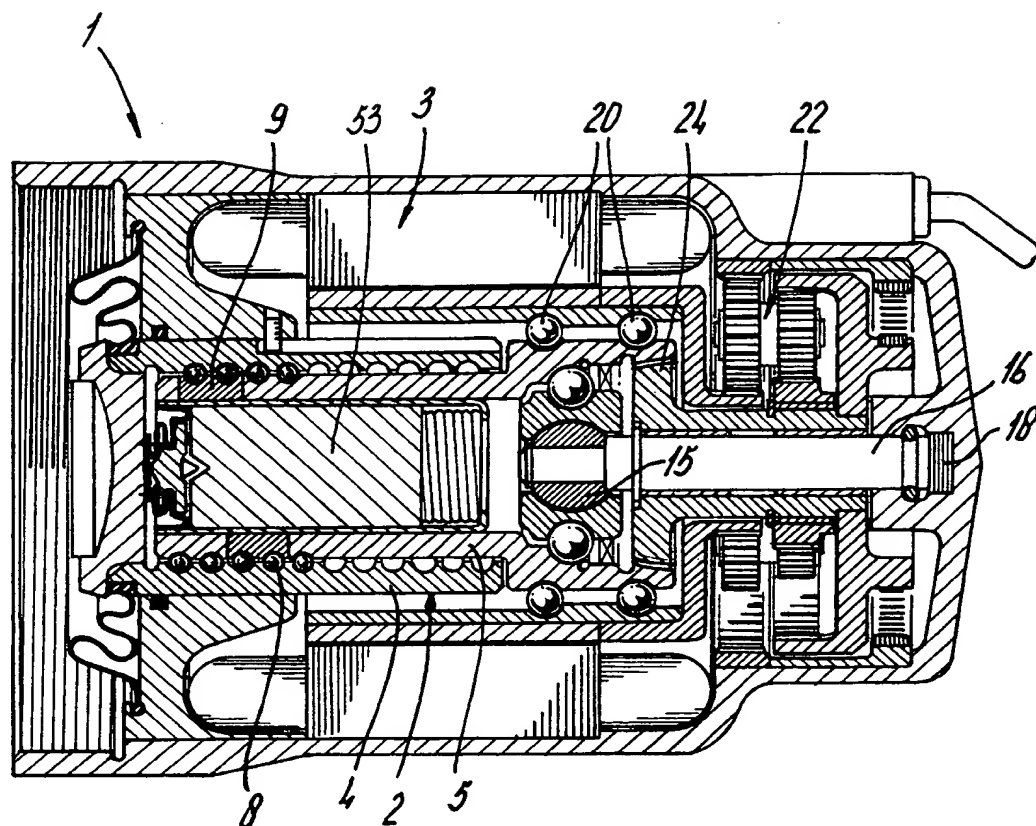


fig-4



## INTERNATIONAL SEARCH REPORT

In. ational Application No

PCT/NL 00/00053

**A. CLASSIFICATION OF SUBJECT MATTER**  
IPC 7 F16D65/16 H02K7/06

According to International Patent Classification (IPC) or to both national classification and IPC

**B. FIELDS SEARCHED**

Minimum documentation searched (classification system followed by classification symbols)

IPC 7 F16D F16H H02K

Documentation searched other than minimum documentation to the extent that such documents are included in the fields searched

Electronic data base consulted during the international search (name of data base and, where practical, search terms used)

**C. DOCUMENTS CONSIDERED TO BE RELEVANT**

Category *	Citation of document, with indication, where appropriate, of the relevant passages	Relevant to claim No.
A	DE 196 52 230 A (ITT AUTOMOTIVE EUROPE) 18 June 1998 (1998-06-18) column 4, line 20 - line 26; figure 1	1
A	US 4 987 788 A (BAUSCH) 29 January 1991 (1991-01-29) claim 1; figure 2	1

☐ Further documents are listed in the continuation of box C.

Patent family members are listed in annex.

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Date of the actual completion of the international search

25 May 2000

Date of mailing of the international search report

31/05/2000

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Becker, R

# INTERNATIONAL SEARCH REPORT

Information on patent family members

International Application No

PCT/NL 00/00053

Patent document cited in search report	Publication date	Patent family member(s)	Publication date
DE 19652230 A	18-06-1998	AU 5853998 A	15-07-1998
		CZ 9902019 A	15-12-1999
		WO 9827357 A	25-06-1998
		EP 0943061 A	22-09-1999
		PL 333929 A	31-01-2000
US 4987788 A	29-01-1991	DE 3836255 A	26-04-1990



## PATENT COOPERATION TREATY

PCT

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NOTIFICATION OF THE RECORDING  
OF A CHANGE(PCT Rule 92bis.1 and  
Administrative Instructions, Section 422)

To:

JORRITSMA, Ruurd  
Nederlandsch Octrooibureau  
Scheveningseweg 82, P.O. Box 29720  
NL-2502 LS The Hague  
PAYS-BAS

Date of mailing (day/month/year) 17 August 2001 (17.08.01)	<b>IMPORTANT NOTIFICATION</b>
Applicant's or agent's file reference BO 42366	
International application No. PCT/NL00/00053	International filing date (day/month/year) 27 January 2000 (27.01.00)

## 1. The following indications appeared on record concerning:

☒ the applicant    ☒ the inventor    ☐ the agent    ☐ the common representative

Name and Address FUCKS, Thomas, Wilhelm Salierallee 54 D-52066 Aachen Germany	State of Nationality DE	State of Residence DE
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	Facsimile No.	
	Teleprinter No.	

## 2. The International Bureau hereby notifies the applicant that the following change has been recorded concerning:


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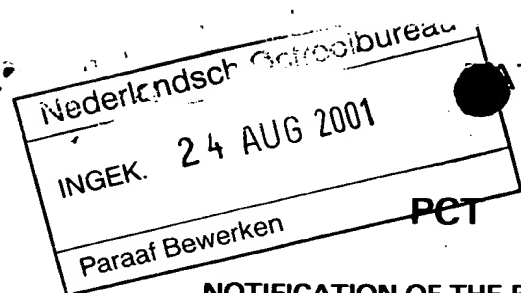
Name and Address FUCKS, Thomas, Wilhelm Rosenweg 2 D-97520 Rothlein Germany	State of Nationality DE	State of Residence DE
	Telephone No.	
	Facsimile No.	
	Teleprinter No.	

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NOTIFICATION OF THE RECORDING  
OF A CHANGE

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Date of mailing (day/month/year) 16 August 2001 (16.08.01)	<b>IMPORTANT NOTIFICATION</b>
Applicant's or agent's file reference BO 42366	
International application No. PCT/NL00/00053	International filing date (day/month/year) 27 January 2000 (27.01.00)

## 1. The following indications appeared on record concerning:

☒ the applicant ☒ the inventor ☐ the agent ☐ the common representative

Name and Address VAN WINDEN, Johannes, Albertus Molenwal 4 NL-3421 CM Oudewater Netherlands	State of Nationality	State of Residence
	Telephone No.	
	Facsimile No.	
	Teleprinter No.	

## 2. The International Bureau hereby notifies the applicant that the following change has been recorded concerning:

☐ the person ☐ the name ☒ the address ☐ the nationality ☐ the residence

Name and Address VAN WINDEN, Johannes, Albertus Monchhofstrasse 3B D-69120 Heidelberg Germany	State of Nationality	State of Residence
	Telephone No.	
	Facsimile No.	
	Teleprinter No.	

## 3. Further observations, if necessary:

## 4. A copy of this notification has been sent to:

☒ the receiving Office ☐ the designated Offices concerned  
☐ the International Searching Authority ☒ the elected Offices concerned  
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<p>The International Bureau of WIPO 34, chemin des Colombettes 1211 Geneva 20, Switzerland</p> <p>Facsimile No.: (41-22) 740.14.35</p>	<p>Authorized officer</p> <p>Anman QIU </p> <p>Telephone No.: (41-22) 338.83.38</p>
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IN THE UNITED STATES PATENT AND TRADEMARK OFFICE

In re the Application of

Hendrikus Jan KAPAAN, Johannes Albertus Attn: PCT Branch  
VAN WINDEN, Jacobus ZWARTS,  
Thomas Wilhelm FUCKS

Application No. U.S. National Stage of PCT/NL00/00053

Filed: July 25, 2001

Docket No.: 110191

For: COMPACT ACTUATOR

**SUBMISSION OF THE ANNEXES TO THE  
INTERNATIONAL PRELIMINARY EXAMINATION REPORT**

Director of the U.S. Patent and Trademark Office  
Washington, D.C. 20231

Sir:

Attached hereto are the annexes to the International Preliminary Examination Report (Form PCT/IPEA/409). The attached material replaces the material in the specification at page 8, line 1 to line 32.

Respectfully submitted,



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REC'D 07 MAY 2001

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## INTERNATIONAL PRELIMINARY EXAMINATION REPORT

(PCT Article 36 and Rule 70)

Applicant's or agent's file reference BO 42366	<b>FOR FURTHER ACTION</b> See Notification of Transmittal of International Preliminary Examination Report (Form PCT/IPEA/416)	
International application No. PCT/NL00/00053	International filing date (day/month/year) 27/01/2000	Priority date (day/month/year) 27/01/1999
International Patent Classification (IPC) or national classification and IPC F16D65/16		
Applicant SKF ENGINEERING AND RESEARCH CENTRE B.V. et al.		

1. This international preliminary examination report has been prepared by this International Preliminary Examining Authority and is transmitted to the applicant according to Article 36.



2. This REPORT consists of a total of 4 sheets, including this cover sheet.

- ☒ This report is also accompanied by ANNEXES, i.e. sheets of the description, claims and/or drawings which have been amended and are the basis for this report and/or sheets containing rectifications made before this Authority (see Rule 70.16 and Section 607 of the Administrative Instructions under the PCT).

These annexes consist of a total of 1 sheets.

3. This report contains indications relating to the following items:

- I ☒ Basis of the report
- II ☐ Priority
- III ☐ Non-establishment of opinion with regard to novelty, inventive step and industrial applicability
- IV ☐ Lack of unity of invention
- V ☒ Reasoned statement under Article 35(2) with regard to novelty, inventive step or industrial applicability; citations and explanations supporting such statement
- VI ☐ Certain documents cited
- VII ☒ Certain defects in the international application
- VIII ☐ Certain observations on the international application

Date of submission of the demand 08/08/2000	Date of completion of this report 03.05.2001
Name and mailing address of the international preliminary examining authority:  European Patent Office D-80298 Munich Tel. +49 89 2399 - 0 Tx: 523656 epmu d Fax: +49 89 2399 - 4465	Authorized officer Krysta, D Telephone No. +49 89 2399 2942 

# INTERNATIONAL PRELIMINARY EXAMINATION REPORT

International application No. PCT/NL00/00053

## I. Basis of the report

1. With regard to the **elements** of the international application (*Replacement sheets which have been furnished to the receiving Office in response to an invitation under Article 14 are referred to in this report as "originally filed" and are not annexed to this report since they do not contain amendments (Rules 70.16 and 70.17)*):

**Description, pages:**

1-5 as originally filed

**Claims, No.:**

1-24 as originally filed

25-33 as received on 03/01/2001 with letter of 02/01/2001

**Drawings, sheets:**

1/4-4/4 as originally filed

2. With regard to the **language**, all the elements marked above were available or furnished to this Authority in the language in which the international application was filed, unless otherwise indicated under this item.

These elements were available or furnished to this Authority in the following language: , which is:

- ☐ the language of a translation furnished for the purposes of the international search (under Rule 23.1(b)).
- ☐ the language of publication of the international application (under Rule 48.3(b)).
- ☐ the language of a translation furnished for the purposes of international preliminary examination (under Rule 55.2 and/or 55.3).

3. With regard to any **nucleotide and/or amino acid sequence** disclosed in the international application, the international preliminary examination was carried out on the basis of the sequence listing:

- ☐ contained in the international application in written form.
- ☐ filed together with the international application in computer readable form.
- ☐ furnished subsequently to this Authority in written form.
- ☐ furnished subsequently to this Authority in computer readable form.
- ☐ The statement that the subsequently furnished written sequence listing does not go beyond the disclosure in the international application as filed has been furnished.
- ☐ The statement that the information recorded in computer readable form is identical to the written sequence listing has been furnished.

4. The amendments have resulted in the cancellation of:

**INTERNATIONAL PRELIMINARY  
EXAMINATION REPORT**

International application No. PCT/NL00/00053

- ☐ the description,      pages:  
☐ the claims,      Nos.:  
☐ the drawings,      sheets:

5. ☐ This report has been established as if (some of) the amendments had not been made, since they have been considered to go beyond the disclosure as filed (Rule 70.2(c)):

*(Any replacement sheet containing such amendments must be referred to under item 1 and annexed to this report.)*

6. Additional observations, if necessary:

**V. Reasoned statement under Article 35(2) with regard to novelty, inventive step or industrial applicability; citations and explanations supporting such statement**

**1. Statement**

Novelty (N)	Yes:	Claims	1-33
	No:	Claims	
Inventive step (IS)	Yes:	Claims	1-33
	No:	Claims	
Industrial applicability (IA)	Yes:	Claims	1-33
	No:	Claims	

2. Citations and explanations:  
**see separate sheet**

**VII. Certain defects in the international application**

The following defects in the form or contents of the international application have been noted:  
**see separate sheet**

**INTERNATIONAL PRELIMINARY  
EXAMINATION REPORT - SEPARATE SHEET**

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International application No. PCT/NL00/00053

**Point V:**

1. In an actuator as disclosed in D1 the rotatable component of a motor driving the screw mechanism is supported by the outer member of the screw mechanism, i.e. typically the nut.

According to independent claim 1 said rotatable component of the actuator is supported by the screw. Such a construction is neither known from nor suggested by the available state of the art.

Therefore, independent claim 1, the following dependent claims 2 to 32 and a brake calliper according to independent claim 33 comprising such an actuator are regarded as being new and inventive.

**Point VII:**

1. The state of the art (see D1) should have been cited in the description (Rule 5 PCT).
2. Only a part of the claims is provided with reference signs (Rule 6 PCT).

03. 01. 2001

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(42)

25. Actuator according to claim 24, wherein the support bearing (11) is supported on one end of a support shaft (16), the other end of which is connected to the housing (1), the externally toothed member (24) being rotatably supported on said support shaft (16).
- 5 26. Actuator according to claim 19 or 20, wherein the rotor of the motor directly engages the outer ring of the support bearing.
27. Actuator according to claim 26, wherein the rotor is integrated with an internally toothed member, and the outer ring of the support bearing is integrated with an externally toothed member, said members engaging each other.
- 10 28. Actuator according to claims 13-27, wherein the screw (5) and the support shaft (16) each have a throughgoing bore, said bores being aligned with respect to each other.
29. Actuator according to any of claims 1-28, wherein the screw (5) comprises a bore, said bore containing a grease dosing unit (53).
- 15 30. Actuator according to any of the preceding claims, wherein at least one of the components of the screw mechanism, support bearing, auxiliary bearing and reduction gear mechanism comprises a surface obtained by hard turning.
31. Actuator according to any of the preceding claims, wherein at least one of the components of the screw mechanism, support bearing, auxiliary bearing and reduction gear mechanism comprises a coating, e.g. a diamond-like carbon coating.
- 20 32. Actuator according to any of the preceding claims, wherein an encoder is provided for measuring a relative rotation.
33. Brake calliper for a disc brake, comprising a claw piece carrying at least two opposite brake pads which enclose a gap for accommodating a brake disc, and an
- 25 actuator according to any of the preceding claims, said actuator having a housing accommodating a screw mechanism and a drive comprising a motor, said screw mechanism comprising a nut and a screw one of which is rotatably supported with respect to the housing, such that upon relative rotation of the nut and the screw a linear movement of one of said nut and screw is obtained, said housing being connected to the
- 30 claw piece, characterised in that at least a rotatable component of the drive, e.g. the rotor of the motor, is rotatably supported on the ~~nut or~~ screw which is rotatably supported with respect to the housing.



25. Actuator according to claim 24, wherein the support bearing (11) is supported on one end of a support shaft (16), the other end of which is connected to the housing (1), the externally toothed member (24) being rotatably supported on said support shaft (16).
- 5 26. Actuator according to claim 19 or 20, wherein the rotor of the motor directly engages the outer ring of the support bearing.
27. Actuator according to claim 26, wherein the rotor is integrated with an internally toothed member, and the outer ring of the support bearing is integrated with an externally toothed member, said members engaging each other.
- 10 28. Actuator according to claims 13-27, wherein the screw (5) and the support shaft (16) each have a throughgoing bore, said bores being aligned with respect to each other.
29. Actuator according to any of claims 1-28, wherein the screw (5) comprises a bore, said bore containing a grease dosing unit (53).
- 15 30. Actuator according to any of the preceding claims, wherein at least one of the components of the screw mechanism, support bearing, auxiliary bearing and reduction gear mechanism comprises a surface obtained by hard turning.
31. Actuator according to any of the preceding claims, wherein at least one of the components of the screw mechanism, support bearing, auxiliary bearing and reduction gear mechanism comprises a coating, e.g. a diamond-like carbon coating.
- 20 32. Actuator according to any of the preceding claims, wherein an encoder is provided for measuring a relative rotation.
33. Brake calliper for a disc brake, comprising a claw piece carrying at least two opposite brake pads which enclose a gap for accommodating a brake disc, and an
- 25 actuator according to any of the preceding claims, said actuator having a housing accommodating a screw mechanism and a drive comprising a motor, said screw mechanism comprising a nut and a screw one of which is rotatably supported with respect to the housing, such that upon relative rotation of the nut and the screw a linear movement of one of said nut and screw is obtained, said housing being connected to the
- 30 claw piece, characterised in that at least a rotatable component of the drive, e.g. the rotor of the motor, is rotatably supported on the nut or screw which is rotatably supported with respect to the housing.

# PCT

## INTERNATIONAL SEARCH REPORT

(PCT Article 18 and Rules 43 and 44)

Applicant's or agent's file reference <b>B0 42366</b>	<b>FOR FURTHER ACTION</b> see Notification of Transmittal of International Search Report (Form PCT/ISA/220) as well as, where applicable, item 5 below.	
International application No. <b>PCT/NL 00/ 00053</b>	International filing date (day/month/year) <b>27/01/2000</b>	(Earliest) Priority Date (day/month/year) <b>27/01/1999</b>
Applicant <b>SKF ENGINEERING AND RESEARCH CENTRE B.V. et al.</b>		

This International Search Report has been prepared by this International Searching Authority and is transmitted to the applicant according to Article 18. A copy is being transmitted to the International Bureau.

This International Search Report consists of a total of 3 sheets.



It is also accompanied by a copy of each prior art document cited in this report.

### 1. Basis of the report

- a. With regard to the **language**, the international search was carried out on the basis of the international application in the language in which it was filed, unless otherwise indicated under this item.



the international search was carried out on the basis of a translation of the international application furnished to this Authority (Rule 23.1(b)).

- b. With regard to any **nucleotide and/or amino acid sequence** disclosed in the international application, the international search was carried out on the basis of the sequence listing :



contained in the international application in written form.



filed together with the international application in computer readable form.



furnished subsequently to this Authority in written form.



furnished subsequently to this Authority in computer readable form.



the statement that the subsequently furnished written sequence listing does not go beyond the disclosure in the international application as filed has been furnished.



the statement that the information recorded in computer readable form is identical to the written sequence listing has been furnished

2. ☐ **Certain claims were found unsearchable** (See Box I).

3. ☐ **Unity of invention is lacking** (see Box II).

4. With regard to the **title**,



the text is approved as submitted by the applicant.



the text has been established by this Authority to read as follows:

5. With regard to the **abstract**,



the text is approved as submitted by the applicant.



the text has been established, according to Rule 38.2(b), by this Authority as it appears in Box III. The applicant may, within one month from the date of mailing of this international search report, submit comments to this Authority.

6. The figure of the **drawings** to be published with the abstract is Figure No.



as suggested by the applicant.



because the applicant failed to suggest a figure.



because this figure better characterizes the invention.

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None of the figures.

# INTERNATIONAL SEARCH REPORT

International application No.

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## Box III TEXT OF THE ABSTRACT (Continuation of item 5 of the first sheet)

An actuator comprises a housing (1) accommodating a screw mechanism (2) and a drive comprising a motor (3), said screw mechanism comprising a nut (4) and a screw (5) one of which is rotatably supported with respect to the housing, such that upon relative rotation of the nut and the screw a linear movement of one said nut and screw is obtained. At least a rotatable component of the drive, e.g the rotor (19) of the motor, is rotatably supported on the screw which is rotatably supported with respect to the housing.

## INTERNATIONAL SEARCH REPORT

International Application No

PCT/NL 00/00053

## A. CLASSIFICATION OF SUBJECT MATTER

IPC 7 F16D65/16 H02K7/06

According to International Patent Classification (IPC) or to both national classification and IPC

## B. FIELDS SEARCHED

Minimum documentation searched (classification system followed by classification symbols)

IPC 7 F16D F16H H02K

Documentation searched other than minimum documentation to the extent that such documents are included in the fields searched

Electronic data base consulted during the international search (name of data base and, where practical, search terms used)

## C. DOCUMENTS CONSIDERED TO BE RELEVANT

Category *	Citation of document, with indication, where appropriate, of the relevant passages	Relevant to claim No.
A	DE 196 52 230 A (ITT AUTOMOTIVE EUROPE) 18 June 1998 (1998-06-18) column 4, line 20 - line 26; figure 1 ---	1
A	US 4 987 788 A (BAUSCH) 29 January 1991 (1991-01-29) claim 1; figure 2 -----	1

☐ Further documents are listed in the continuation of box C.☒ Patent family members are listed in annex.

## \* Special categories of cited documents :

"A" document defining the general state of the art which is not considered to be of particular relevance

"E" earlier document but published on or after the international filing date

"L" document which may throw doubts on priority claim(s) or which is cited to establish the publication date of another citation or other special reason (as specified)

"O" document referring to an oral disclosure, use, exhibition or other means

"P" document published prior to the international filing date but later than the priority date claimed

"T" later document published after the international filing date or priority date and not in conflict with the application but cited to understand the principle or theory underlying the invention

"X" document of particular relevance; the claimed invention cannot be considered novel or cannot be considered to involve an inventive step when the document is taken alone

"Y" document of particular relevance; the claimed invention cannot be considered to involve an inventive step when the document is combined with one or more other such documents, such combination being obvious to a person skilled in the art.

"&amp;" document member of the same patent family

Date of the actual completion of the international search

25 May 2000

Date of mailing of the international search report

31/05/2000

Name and mailing address of the ISA

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NL - 2280 HV Rijswijk  
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Authorized officer

Becker, R

## INTERNATIONAL SEARCH REPORT

Information on patent family members

International Application No

PCT/NL 00/00053

Patent document cited in search report	Publication date	Patent family member(s)	Publication date
DE 19652230 A	18-06-1998	AU 5853998 A	15-07-1998
		CZ 9902019 A	15-12-1999
		WO 9827357 A	25-06-1998
		EP 0943061 A	22-09-1999
		PL 333929 A	31-01-2000
US 4987788 A	29-01-1991	DE 3836255 A	26-04-1990

## PATENT COOPERATION TREATY

PCT

## NOTIFICATION OF ELECTION

(PCT Rule 61.2)

From the INTERNATIONAL BUREAU

To:

Assistant Commissioner for Patents  
United States Patent and Trademark  
Office  
Box PCT  
Washington, D.C.20231  
ETATS-UNIS D'AMERIQUE

in its capacity as elected Office

Date of mailing (day/month/year)

11 September 2000 (11.09.00)

International application No.

PCT/NL00/00053

Applicant's or agent's file reference

BO 42366

International filing date (day/month/year)

27 January 2000 (27.01.00)

Priority date (day/month/year)

27 January 1999 (27.01.99)

Applicant

KAPAAN, Hendrikus, Jan et al

1. The designated Office is hereby notified of its election made:



in the demand filed with the International Preliminary Examining Authority on:

08 August 2000 (08.08.00)



in a notice effecting later election filed with the International Bureau on:

2. The election ☒ was

was not

made before the expiration of 19 months from the priority date or, where Rule 32 applies, within the time limit under Rule 32.2(b).

The International Bureau of WIPO  
34, chemin des Colombettes  
1211 Geneva 20, Switzerland

Facsimile No.: (41-22) 740.14.35

Authorized officer

Olivia TEFY

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